What is claimed is:

1. An ion source for matrix-assisted laser desorption/ionization comprising:

a sample holder having a sample surface;

an optical system configured to irradiate a sample on the sample surface with a pulse of energy such that the pulse of energy strikes a sample on the sample surface at an angle within 10 degrees of the normal of the sample surface; and

a first ion optics system configured to extract sample ions in a first direction substantially normal to the sample surface.

2. The ion source of claim 1, wherein the optical system is configured to irradiate a sample on the sample surface with a pulse of energy such that the pulse of energy strikes a sample on the sample surface at an angle within 1 degree of the normal of the sample surface.

3. The ion source of claim 1, wherein the pulse of energy is substantially coaxial with the first direction.

4. The ion source of claim 1, wherein the first ion optics system comprises:

a first electrode disposed between the sample holder and a second electrode, the first electrode having an aperture and the second electrode having an aperture; and

a first ion optical axis defined by the line between the center of the aperture in the first electrode and the center of the aperture in the second electrode, the first ion optical axis intersecting the sample surface at an angle within 5 degrees of the normal of the sample surface.

5. The ion source of claim 4, wherein the first ion optical axis intersects the sample surface at an angle within 1 degree of the normal of the sample surface.

6. The ion source of claim 4, further comprising:

a heater system connected to the first electrode and the second electrode; and

a temperature-controlled surface disposed substantially around the first electrode and the second electrode.

7. The ion source of claim 4, wherein the first ion optics system further comprises an ion deflector disposed between the first electrode and the second electrode, the ion deflector configured to deflect sample ions in a second direction.

8. The ion source of claim 7, wherein the ion source further comprises a third electrode displaced from the ion deflector in a direction opposite the second electrode, the third electrode positioned to receive sample ions traveling along the second direction.

9. The ion source of claim 8, wherein the third electrode is also positioned such that neutral molecules traveling from the sample holder in the first direction do not substantially collide with the third electrode.

10. The ion source of claim 1, further comprising a second ion optics system displaced from the first ion optics system in a direction opposite the sample holder, the second ion optics system configured to deflect sample ions in a second direction.

11. The ion source of claim 10, wherein the second ion optics system comprises a first ion deflector.

12. The ion source of claim 10, wherein the second ion optics system further comprises a third electrode displaced from the first ion deflector in a direction opposite the first ion optics system.

13. The ion source of claim 10, further comprising a third ion optics system displaced from the second ion optics system in a direction opposite the first ion optics system, the third ion optics system configured to receive sample ions traveling along the second direction and to deflect the sample ions in a third direction.

14. The ion source of claim 13, wherein the third ion optics system comprises a fourth electrode having an aperture, the fourth electrode positioned such that neutral molecules traveling from the sample holder in the first direction do not substantially collide with the fourth electrode.

15. The ion source of claim 14, wherein the third ion optics system further comprises a second ion deflector positioned such that neutral molecules traveling from the sample holder in the first direction do not substantially collide with the second ion deflector.

16. An ion source for matrix-assisted laser desorption/ionization comprising:

a sample holder having a sample surface;

an optical system configured to irradiate a sample on the sample surface with a pulse of energy at an irradiation angle and generate sample ions by matrix-assisted laser desorption/ionization; and

a first ion optics system configured to extract the sample ions in an extraction direction to form an ion beam, wherein the irradiation angle and extraction direction are such that the angle of the trajectory at the exit from the

first ion optics system of sample ions substantially at the center of the ion beam is substantially independent of sample ion mass.

17. The ion source of claim 16, wherein the irradiation angle is substantially coaxial with the extraction direction.

18. The ion source of claim 27, wherein the first ion optics system comprises:

a first electrode disposed between the sample holder and a second electrode, the first electrode having an aperture and the second electrode having an aperture; and

a first ion optical axis defined by the line between the center of the aperture in the first electrode and the center of the aperture in the second electrode, the first ion optical axis intersecting the sample surface at an angle within 1 degrees of the normal of the sample surface.

19. The ion source of claim 18, further comprising:

a heater system connected to the first electrode and the second electrode; and

a temperature-controlled surface disposed substantially around the first electrode and the second electrode.

20. The ion source of claim 18, wherein the first ion optics system further comprises an ion deflector disposed between the first electrode and the second electrode, the ion deflector configured to deflect sample ions in a second direction.

21. The ion source of claim 20, wherein the ion source further comprises a third electrode displaced from the ion deflector in a direction opposite the second electrode, the third electrode positioned to receive sample ions traveling along the second direction.

22. The ion source of claim 21, wherein the third electrode is also positioned such that neutral molecules traveling from the sample holder in the extraction direction do not substantially collide with the third electrode.

23. The ion source of claim 16, further comprising a second ion optics system displaced from the first ion optics system in a direction opposite the sample holder, the second ion optics system configured to deflect sample ions in a second direction.

24. The ion source of claim 23, wherein the second ion optics system comprises a first ion deflector.

25. The ion source of claim 24, wherein the second ion optics system further comprises a third electrode displaced from the first ion deflector in a direction opposite the first ion optics system.

26. The ion source of claim 23, further comprising a third ion optics system displaced from the second ion optics system in a direction opposite the first ion optics system, the third ion optics system configured to receive sample ions traveling along the second direction and to deflect the sample ions in a third direction.

27. The ion source of claim 26, wherein the third ion optics system comprises a fourth electrode having an aperture, the fourth electrode positioned such that neutral molecules traveling from the sample holder in the extraction direction do not substantially collide with the fourth electrode.

28. The ion source of claim 27, wherein the third ion optics system further comprises a second ion deflector positioned such that neutral molecules traveling from the

sample holder in the extraction direction do not substantially collide with the second ion deflector.

29. An ion source for matrix-assisted laser desorption/ionization comprising:

a sample holder having a sample surface;

a first electrode disposed between the sample holder and a second electrode, the first electrode having an aperture and the second electrode having an aperture;

an extraction direction defined by the line between the center of the aperture in the first electrode and the center of the aperture in the second electrode; and

an optical system configured to irradiate a sample on the sample surface with a pulse of energy having a Poynting vector, the optical system configured such that the Poynting vector is substantially coaxial with the extraction direction.

30. The ion source of claim 29, wherein the Poynting vector intersects the sample surface at an angle in the range between about 5 degrees and 50 degrees with respect to the normal of the sample surface.

31. The ion source of claim 29, further comprising:

a heater system connected to the first electrode and the second electrode; and

a temperature-controlled surface disposed substantially around the first electrode and the second electrode.

32. An ion source for matrix-assisted laser desorption/ionization comprising:

a sample holder having a sample surface;

an optical system configured to irradiate a sample on the sample surface with a pulse of energy and generate sample ions by matrix-assisted laser desorption/ionization

a first ion optics system configured to extract sample ions;

a heater system connected to the first ion optics system; and

a temperature-controlled surface disposed substantially around the first ion optics system.

33. The ion source of claim 32, wherein the optical system is configured such that the pulse of energy strikes a sample on the sample surface at an angle within 10 degrees of the normal of the sample surface.

34. The ion source of claim 32, wherein the first ion optics system comprises:

a first electrode disposed between the sample holder and a second electrode; and wherein, the heater system is connected to the first electrode and the second electrode.

35. The ion source of claim 34, wherein:

the first electrode has an aperture;

the second electrode has an aperture; and

a first ion optical axis is defined by the line between the center of the aperture in the first electrode and the center of the aperture in the second electrode, the first ion optical axis intersecting the sample surface at an angle within 5 degrees or less of the normal of the sample surface.

36. The ion source of claim 35, wherein the first ion optics system further comprises:

an ion deflector disposed between the first electrode and the second electrode, the ion deflector configured to deflect sample ions in second direction; and wherein, the heater system is connected to the ion deflector.

37. The ion source of claim 36, wherein the ion source further comprises: a third electrode displaced from the second electrode in a direction opposite the first electrode, wherein the third electrode is positioned to receive sample ions traveling along the second direction and positioned such that neutral molecules traveling from the sample holder along the first ion optical axis do not substantially collide with the third electrode.

38. The ion source of claim 35, wherein the first ion optics system further comprises: a third electrode displaced from the second electrode in a direction opposite the first electrode; and wherein, the heater system is connected to the third electrode.

39. The ion source of claim 38, wherein the first ion optics system further comprises: a first ion deflector disposed between the second electrode and the third electrode, the first ion deflector configured to deflect sample ions in second direction; and wherein, the heater system is connected to the first ion deflector.

40. The ion source of claim 39, wherein the ion source further comprises: a second ion optics system displaced from the third electrode in a direction opposite the second electrode, wherein the second ion optics system is positioned to receive sample ions traveling along the second direction and deflect the sample ions in a third direction.

41. The ion source of claim 40, wherein the second ion optics system is also positioned such that neutral molecules traveling from the sample holder along the first ion optical axis do not substantially collide with the second ion optics system.

42. The ion source of claim 39, wherein the second ion optics system comprises:

    a second deflector; and

    a fourth electrode.

43. A mass analyzer system comprising:

    a sample holder having a sample surface;

    an optical system configured to irradiate a sample on the sample surface with a pulse of energy such that the pulse of energy strikes a sample on the sample surface at an angle within 10 degrees or less of the normal of the sample surface;

    a first ion optics system disposed between the sample holder and the mass analyzer, the first ion optics system configured to extract ions along a first ion optical axis, the first ion optical axis intersecting the sample surface at an angle within 5 degrees or less of the normal of the sample surface;

    a second ion optics system disposed between the first ion optics system and the mass analyzer, the second ion optics system configured to deflect ions from the first ion optical axis and onto a second ion optical axis; and

    a mass analyzer.

44. The mass analyzer system of claim 43, wherein the pulse of energy is substantially coaxial with the first ion optical axis.

45. The mass analyzer system of claim 43, wherein the first ion optics system comprises a first electrode having an aperture; and wherein, the first ion optical axis passes through the center of the aperture in the first electrode.

46. The mass analyzer system of claim 45, wherein the second ion optics system comprises a first ion deflector disposed between the first electrode and a second electrode.

47. The mass analyzer system of claim 46, further comprising a third ion optics system positioned to receive sample ions traveling along the second ion optical axis and configured to deflect ions from the second ion optical axis and into the mass analyzer.

48. The mass analyzer system of claim 47, wherein the third ion optics system comprises a third electrode.

49. The mass analyzer system of claim 47, wherein the third ion optics system comprises a third electrode and a second ion deflector.

50. The mass analyzer system of claim 43, wherein the first ion optics system comprises:

a first electrode disposed between the sample holder and a second electrode;

the first electrode having an aperture and the second electrode having an aperture, wherein, the first ion optical axis is coincident with the line between the center of the aperture in the first electrode and the center of the aperture in the second electrode.

51. The mass analyzer system of claim 50, wherein the second ion optics system comprises a first ion deflector disposed between the second electrode and a third electrode.

52. The mass analyzer system of claim 51, further comprising a third ion optics system positioned to receive sample ions traveling along the second ion optical axis and configured to deflect ions from the second ion optical axis and into the mass analyzer.

53. The mass analyzer system of claim 52, wherein the third ion optics system comprises a fourth electrode.

54. The mass analyzer system of claim 52, wherein the third ion optics system comprises a fourth electrode and a second ion deflector.

55. The mass analyzer system of claim 43, further comprising:
a heater system connected to the first ion optics system; and
a temperature-controlled surface disposed substantially around the first ion optics system.

56. The mass analyzer system of claim 43, further comprising:
a heater system connected to the second ion optics system; and
a temperature-controlled surface disposed substantially around the second ion optics system.

57. The mass analyzer system of claim 43, further comprising a sample blank sample holder for collecting at least a portion of vaporized matrix molecules on the blank when heating the first ion optics system to vaporize matrix molecules deposited thereon.

58. The mass analyzer system of claim 43, wherein the mass analyzer comprises at least one of a time-of-flight, quadrupole, RF multipole, magnetic sector, electrostatic sector, ion mobility spectrometer, and ion reflector.

59. A method of providing sample ions for mass analysis comprising the steps of:
providing a sample surface having disposed thereon a sample;

irradiating the sample with a pulse of energy at an irradiation angle that is within 10 degrees or less of the normal of the sample surface to form sample ions by matrix-assisted laser desorption/ionization; and

extracting sample ions in a direction substantially normal to the sample surface with a first ion optics system.

60. The method of claim 59, further comprising the steps of:

deflecting the sample ions in a second direction different from the direction substantially normal to the sample surface; and

focusing the sample ions into a mass analyzer.

61. The method of claim 60, wherein the step of deflecting the sample ions in a second direction comprises applying a voltage to a first ion deflector wherein the voltage applied to first ion the deflector to achieve a certain deflection is susbtantially independent of sample ion mass.

62. The method of claim 59, further comprising the steps of:

deflecting the sample ions in a second direction different from the direction substantially normal to the sample surface;

deflecting the sample ions in a third direction different from the second direction; and

focusing the sample ions into a mass analyzer.

63. The method of claim 62, wherein:

the step of deflecting the sample ions in a second direction comprises applying a voltage to a first ion deflector wherein the voltage applied to first ion the deflector is to achieve a certain deflection is susbtantially independent of sample ion mass; and

the step of deflecting the sample ions in a third direction comprises applying a voltage to a second ion deflector wherein the voltage applied to second ion the deflector to achieve a certain deflection is susbtantially independent of sample ion mass.

64. The method of claim 59, further comprising the steps of:

replacing the sample surface with a blank;

heating the first ion optics system to vaporize matrix molecules deposited thereon; and

collecting at least a portion of the vaporized matrix molecules on the blank.

65. A method of providing sample ions for mass analysis comprising the steps of:

producing sample ions by matrix-assisted laser desorption/ionization; and

extracting sample ions using an accelerating electrical field to form an ion beam;

wherein the angle of the trajectory at the exit from the accelerating electrical field of sample ions substantially at the center of the ion beam is substantially independent of sample ion mass.